

PATENT SPECIFICATION

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- (21) Application No. 10618/76 (22) Filed 17 March 1976
 (31) Convention Application No. 2391/74
 (32) Filed 19 March 1975 in
 (33) Ireland (IE)
 (44) Complete Specification published 16 May 1979
 (51) INT CL² A61B 17/11
 (52) Index at acceptance A5R BP



(54) IMPROVEMENTS RELATING TO SURGICAL INSTRUMENTS

(71) We, ERWIN HANS HUBRICH, a German citizen, of 176 Clonkeen Crescent, Kill O'Grange, Dunlaoghaire, County Dublin, Ireland, and THOMAS VINCENT KEAVENY, a citizen of the Republic of Ireland, of 11 Salzburg, Ardilea, Roebuck, Dublin 14, Ireland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to instruments for use in surgery, and in particular to instruments for use in vascular surgery.

In vascular surgery, when carrying out a by-pass operation, it may be necessary to develop a "tunnel" in the superficial tissues, where the by-pass can be placed. The by-pass may be either a natural vein-graft or a synthetic prosthesis. The most common site for this operation is in the thigh, in preparation for a vein by-pass from the common femoral artery to the popliteal artery, in cases where the superficial femoral artery is blocked. A similar procedure, using a synthetic graft, can be carried out between a subclavian artery and a femoral artery, or between the femoral arteries of the left and the right sides.

It is an object of the present invention, to provide an instrument which will enable such operations to be carried out in a reliable and effective manner.

According to the invention, there is provided a surgical instrument comprising a substantially rigid elongated shaft, having a head at one end thereof, which is shaped so as to facilitate it being passed through tissue, either so as to form a "tunnel" therein, or by way of a "tunnel" previously formed, and a handle at the other end of the shaft, to enable the instrument to be manipulated, the head and the handle being of enlarged form relatively to the diameter of the shaft and the head tapering towards a rounded tip which forms, in use, the leading end of the instrument.

By the term "substantially rigid" we mean that the material from which the shaft is made

possesses such a degree of rigidity that the shaft is a non-flexible self-supporting element, without however, excluding the possibility that the shaft may be malleable or bendable to a sufficient extent to enable the shaft to be bent when required. The degree of rigidity in the shaft must be such as to ensure that the instrument can be pushed through tissue head foremost.

Instruments in accordance with the invention may be conveniently supplied in sets, the individual instruments in a set having heads of differing shapes and dimensions so as to facilitate, for example, the initial opening up of a tunnel and its subsequent enlargement. Moreover, an instrument may be supplied having its head perforated so as to enable a vein or prosthesis to be attached thereto, for the purpose of drawing it through a previously formed tunnel.

The invention will be more clearly understood from the following description, given by way of example only, of a set of three tunneling instruments, as shown in the accompanying drawings.

In the drawings:

Figure 1 is a side view of one of the instruments of the set and

Figure 2 is a "broken" view on a scale larger than Figure 1, depicting a shaft and handle as shown in Figure 1 together with the three different heads of the three instruments of the set, shown respectively in Figures 2a, 2b and 2c. Figure 2b shows the head already depicted in Figure 1, both in side view as in Figure 1 and also in front view.

In practice, the three instruments are each approximately 20 cm in overall length. They may be made from metal, such as plated brass or stainless steel, or from synthetic material or combinations of these materials.

As can be seen in the drawings, each instrument consists of a substantially rigid shaft 1, carrying a head 2 at one end and a handle 3 at the other end, which are of enlarged form relatively to the diameter of the shaft. The heads of the three instruments of the set are

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shown in detail in Figures 2a, 2b and 2c, the individual heads being marked 2A, 2B and 2C. The handle 3 is of the same shape in each case, being in the form of a flattened round knob. The heads 2A, 2B and 2C of the three instruments are of somewhat differing shapes, but in each case the head tapers towards a rounded tip which forms, in use, the leading end of the instrument.

The head 2A of the instrument shown in Figure 2a is of bulbous shape, tapering towards its rounded tip 11, and having conical leading and trailing surfaces 12 and 13. Thus the head 2A is in the form of a body of revolution, which is substantially symmetrical with regard to the zone 14 of maximum diameter.

The head 2B shown in Figure 2b is larger than the head 2A. It is of smoothly rounded shape and, as can be seen in Figures 1 and 2b, it is of flattened form. The leading end 21 of the head 2B in particular, is seen to be rounded, as viewed in front view in Figure 2b, so as to ensure that it will open up tissue through which it passes, while causing the least possible damage. Due to the relatively large form of the head 2B, it is convenient for this head to be formed with a central opening 22.

Like the head 2A, the head 2C of the instrument shown in Figure 2c is also in the form of a body of revolution but it is of a more slender elongated form than the head 2A. Moreover, instead of being symmetrical, its leading conical surface 32 is less steeply inclined than its trailing surface 33. The tip 31 is smoothly rounded and, near the tip, the head 2C is formed with a perforation or eye 34.

The shaft 1 of each of the above-described instruments is malleable, so that it can be bent as necessary to suit any particular situation. One typical configuration for the shaft 1 is shown in the drawings.

In carrying out tunnelling using these instruments, following the initial dissection, e.g. at the groin, the small-headed instrument shown in Figure 2a is first of all inserted and is passed downwardly through the tissue so as to initiate the opening up of the desired route.

This instrument is then withdrawn and the larger-headed instrument of Figure 2b is inserted in order to enlarge the tunnel, so that it is approximately of a size adequate to accommodate three fingers.

This instrument is then withdrawn and the perforated instrument of Figure 2c is inserted and passed downwardly until its head 2C emerges at the other end of the tunnel. The smoothly rounded shape of the tip 31 of the head 2C, ensures that the head can readily be passed through the previously formed tunnel, without causing any further damage to the surrounding tissue. A vein-graft or prosthesis is next connected to the instrument by means of a suture which is passed through the vein or prosthesis and through the perfora-

tion 34 in the head 2C. The instrument is then drawn upwards, so that the graft is pulled through the tunnel in a single movement, and the anastomosis is completed.

The design of the heads of the respective instruments allows an adequate space to be prepared without tearing small blood vessels and nerves, and ensures sufficient space in the tunnel to prevent entrapment and blockage of the graft. Furthermore, in the case of the instrument of Figure 2c, the length thereof is sufficient to ensure that the graft can be drawn through the entire length of the tunnel in one continuous movement and this helps to reduce the possibility of kinking. Since the shaft is malleable, this enables the requirements of different areas to be met, and the handle shape provides a smooth grip and delicate manipulation.

Although the shaft of an instrument in accordance with the invention is substantially rigid, the head of the instrument may be made of a relatively flexible material, such as the material known by the Trade Mark "Teflon" for example. In the case of the instrument shown in Figure 2b, the provision of the opening 22 then serves to increase the flexibility of the head 2B still further.

The particular instruments referred to above have been described by way of example only, and they may be modified in various ways, within the scope of the invention.

WHAT WE CLAIM IS:—

1. A surgical instrument comprising a substantially rigid elongated shaft (as herein defined), having a head at one end thereof, which is shaped so as to facilitate it being passed through tissue, either so as to form a "tunnel" therein, or by way of a "tunnel" previously formed, and a handle at the other end of the shaft, to enable the instrument to be manipulated, the head and the handle being of enlarged form relatively to the diameter of the shaft and the head tapering towards a rounded tip which forms, in use, the leading end of the instrument.

2. An instrument according to claim 1, wherein the head is in the form of a body of revolution.

3. An instrument according to claim 1, wherein the head is of flattened form.

4. An instrument according to claim 3, wherein the head is formed with an opening.

5. An instrument according to claim 2, wherein the head comprises two substantially conical surfaces, which may be symmetrical or non-symmetrical relative to the zone of maximum diameter of the head.

6. An instrument according to claim 2 or claim 5, wherein the head is of elongated form.

7. An instrument according to claim 6, wherein the elongated head is formed with an eye by means of which a vein-graft or pros-

thesis can be attached to the head.

8. An instrument according to any of the preceding claims, wherein the handle comprises a flattened round knob.

5 9. An instrument according to any of the preceding claims, which is made at least partly of metal.

10 10. An instrument according to any of the preceding claims, which is made at least partly of synthetic plastics material.

11. An instrument according to claim 9, wherein the shaft is made of a malleable metal, so that it can be bent as necessary to suit any particular situation.

15 12. An instrument according to claim 10, wherein the head is made of a relatively

flexible synthetic plastics material.

13. An instrument according to claim 10, wherein the head is made of the material known by the Trade Mark "Teflon".

14. In combination, two or more instruments according to any of the preceding claims forming a set, and having heads of different shapes.

15. A surgical instrument substantially as herein described with reference to and as shown in Figures 1, 2 and 2b or Figures 2 and 2a or Figures 2 and 2c of the accompanying drawings.

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